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REPAIR OF FLOATING PIER FOR RR FERRY  
ACROSS YANGTZE RIVER AT NANKING

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The south bank pier, for the railway ferry across the Yangtze River at Hanking, collapsed on 21 August 1950. Partial repairs made possible the emergency use of the pier and accessory installations from 6 September; full repairs were completed at 2400 on 28 September 1950 when regular through train service was resumed.

A. Description of Pier

The Yangtze River Railway Ferry piers are two movable bridges (gangplank type) on the banks of the Yangtze River, one at Heia-kuan, Nanking, and the other at P'u-k'ou, across the river. Each pier consists of four spans of lattice-girder type trusses. The shore end of span No 4 is stationary, the other spans are movable. With the exception of span No 1 (the one nearest the river) which is 46.34 meters (152 feet) long, the trusses are 46.95 meters (154 feet) long. The total length of each pier is thus 187.19 meters (614 feet). The height of the trusses is 7.72 meters (25.4 feet), and their width is 6.09 meters (20 feet), except that span No 1 at its outer end fans out to a width of 13.41 meters (44 feet) to permit the laying of three railway tracks. The spans are articulated by hinge joints.

A steel frame tower stands at the juncture of each two spans and at the outer end of span No 1. Mounted on the joint pins are plates which carry large nuts that engage the lower ends of threaded rods suspended from the upper parts of the towers. These rods are connected with electric motors in the towers, and their rotation, by electric power, in engagement with the nuts, raises and lowers the spans so that the whole pier is at the proper inclination to insure that the outer end of span No 1 is on a level with the deck of the ferryboat. A movable apron, hinged at one end to the outer end of span No 1 is intended to rest on the deck of the adjacent end of the ferryboat. This apron is 15.85 meters (52 feet) long; its outer end is raised and lowered by electrically operated steel cables.

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B. Damage Sustained by Pier

At 1200 on 21 August 1950, while some repairs were being made in the tower to the downstream side of span No 1, one of the large screw rods had been loosened from its attachments. Since the timbers temporarily supporting the under side of span No 1 were of insufficient strength to sustain the weight of the span, one corner of the downstream side of span No 1 dropped down into the water to a depth of about 6.5 meters; and the end of the pier deck reached a deflection of about 30 degrees. The other three corners retained, in general, their original position, so that the span was wrenched badly out of shape. The upright screw rods in the tower at the junction of spans No 1 and No 2 were broken. Five horizontal members of the truss were bent twisted or broken, as were also some members in the upper chords of the truss. The whole deck of span No 1 was badly warped, especially sections 5 and 6. The crossbeam at the outer tower separated from its screw nuts and hung down above the water. The threaded rods and plates on both sides were bent. Altogether, the damage was quite serious. Fortunately, the near end of span No 2 and tie plates were only slightly damaged. The accident occurred during the noon hour when no men were at work on the pier, so no one was killed or injured.

C. Restoration Plans

Shortly after the accident, the Shanghai Railway Bureau assembled a strong force of engineers and skilled workmen to work on restoration of the Ferry in cooperation with the regular operating staff. The first step was to raise the span to its proper position. At first it was thought that this could be done by floating one or more large barges or lighters under the span, but the water was too shallow to permit this. Then it was decided to use blocks and tackle attached to the top of the nearest tower, and as the span was raised to construct under it for support cribs built of railroad ties which would make possible emergency use of the pier pending full restoration.

The weight to be raised, including the effort of overcoming the resistance of bent members, was estimated at about 85 tons. To accomplish this two blocks of five sheaves and two blocks of four sheaves using wire rope and winches were employed. A 45-ton locomotive crane belonging to the Tsinan Railway Bureau was brought from P'u-k'ou across the river on the ferryboat Nanking. From the place where it was anchored, this crane was to raise the outer end of the apron which was bent at an angle of 30 degrees from the normal. Furthermore, because the upper members of the truss were twisted out of shape, it was decided to erect, upon a crib to be built in a suitable location, a tripod of poles to support a gin-block with pulley having three sheaves to be attached to the upper corner of the downstream side of the truss. The advantage of this was that it would not only help in the raising of the main girders of the truss but would also reduce, to an appreciable extent, the load on the blocks attached to the tower.

Since the water below the fallen truss was only some 2.2 meters deep, it was decided to dump rock under the crossbeams of the first span up to within 0.5 meters of the surface of the water, then pile on a layer of sandbags to get a smooth and solid surface, and upon these to build cribs which could be built higher as the truss was raised so as to support it in case the hoisting tackle should slip or break.

It was decided in advance that when the truss was raised to its proper position, it would be permitted to rest on these cribs while any temporary structures used in the raising operations, which might obstruct the use of the span, were removed and the broken or bent members, such as plates, threaded rods, girders, etc., were repaired or replaced. Temporarily, the raising or lowering of the span would then depend upon the use of jackscrews placed on the top

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of the cribs, adjusted in height if necessary. An examination of the hydro-graphic records for this location showed that the variation in height of water due to the tide would not be greater than 6 centimeters during the ensuing month. This indicated that frequent changes in the height of the cribs would not be required. During the period needed for the repair of the related mechanism, the raising and lowering of the apron was to be effected by using block and tackle attached to the tower.

D. Restoration1. Difficulties

Tools and machinery needed for the job soon began to arrive, mostly from the equipment of the Shanghai Railway Bureau's Bridge-work Section. Two shifts a day of 10 hours each, 0500 to 1500 and from 1500 to 2100, were organized. For a while, some of the workmen spent from 6 to 7 hours continuously in water 2 meters deep preparing footings for jackscrews. By 27 August, the hoisting mechanisms were ready for use. On the first day, the span was raised about 2 meters. One serious concern, as the span was being raised, was how to prevent the threaded lifting rods from being damaged and to insure that they would enter properly the screw nuts with which they should engage; another was how to prevent the span from scraping the concrete foundations of the steel tower and interfering with the hoisting. But these difficulties were all overcome and at 0900, on 30 August, the span was again in its proper position. The distortions of the structure proved to be much less serious than was anticipated.

2. Construction of Cribbing

The local authorities provided all the labor needed for delivering and handling the 1,550 cubic meters of rock and the rail ties used in building seven cribs.

3. Arrangements for Resumption of Through Train Service

On 5 September, the hoisting apparatus and other obstructions had been removed and everything was ready for a test run. It was found that 25 minutes were required for lowering and 50 minutes for raising the apron by manual labor with the device employed. This time was satisfactorily reduced by using the anchor winches on the ferryboat to operate the hoisting tackle. On the same day, a dredger began deepening the approach to the pier. At 0800, on 6 September, through train service was resumed, and on the succeeding days, due to training and experience, the embarkation and debarkation of trains was further greatly expedited.

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